TURFGRASS MANAGEMENT
& ENVIRONMENTAL QUALITY

# Water Quality

## & Commercial Lawn Care

### Best Management Practices (BMPs)

Pollution of surface and groundwater is a serious environmental issue. Best Management Practices (BMPs) are procedures used to maintain turf in environmentally friendly ways. Follow the suggestions and BMPs described in this publication to reduce sediment and keep nutrients and pesticides applied to turf from contaminating North Carolina's water resources. Regulations that apply to watersheds in the Neuse River Basin and the Tar-Pamlico River Basin call for buffers and additional measures to protect water quality (see *http://www.neuse.ncsu.edu/rules1.html).* Similar regulations may be applied to other river basins in the future.

### Turfgrass Selection

Grasses differ in their performance and cultural requirements across regions and locations. When you select a grass variety for a new site, consider how the area will be used and evaluate the soil type, pH, irrigation options, available sunlight, and topography. Take the expected management intensity into account. Adapted, improved grasses require less fertilizer and pesticide and will need less frequent irrigation. The correct variety will be healthier and better able to compete with weeds, resist insects and diseases, and recover from environmental stress. Seed and plant material that is free of weed content will have fewer weed problems and need fewer herbicide treatments. For a list of grasses that perform well in your area, check with your county Extension Center. Additional information is in Cooperative Extension publication, *Carolina Lawns* (AG-69) and on the Web at *www.turffiles.ncsu.edu.*



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## Fertilizers

Lawn care managers should know how and when plants use nutrients and what happens to nutrients in the soil. With this information, you can implement a fertility program that will benefit the turf and minimize risks to water sources. Improper fertilization practices, particularly poor timing, excessive applications, or use of inappropriate forms of phosphorus and nitrogen, pose a risk to water quality.

### Phosphorus

Phosphorus is important in the establishment and rooting of plants. In most soils, phosphorus moves very little, but it may leach into groundwater through very sandy and organic soils. Because phosphorus is generally attached to soil particles, most phosphorus movement comes from sediment eroding from disturbed soils. Water-soluble forms of phosphorus can be lost in surface runoff. When phosphorus gets to surface waters, it can cause undesirable algal blooms and abnormal growth of aquatic plants.

### Nitrogen

Excess nitrogen may increase susceptibility to disease and accumulation of thatch. It may also restrict the root system, reduce wear tolerance, and decrease potential for recovery from environmental stress or pest attacks. Tables 1 and 2 provide guidelines for appropriate levels and timing of N fertilization for common turfgrasses.

The form of nitrogen applied in fertilizer can affect the degree of runoff or leaching. Nitrate ($NO_3$) is likely to leach or run off into water sources. Runoff can occur if the nitrogen is applied to frozen ground, to steep slopes, at high rates, or before irrigation or hard rain. Leaching is likely to occur on coarse-textured sandy soils with low capacity to hold water and low organic matter content.

### Nitrogen Carriers

The form in which nitrogen is supplied to the soil plays an important role in the potential for water contamination.Generally, nitrogen sources are either quick release or slow release (see Table 3).

Quick-release forms of nitrogen stimulate a rapid response by releasing large quantities of nitrogen into the soil. Under some environmental conditions, however, quick-release forms have a high potential for foliage burn and leaching. Inorganic salts (ammonium nitrate) dissolve rapidly in the soil water and provide large amounts of plant-available nitrogen in a short time. Urea is a quickly available, organic nitrogen source that can be applied in either

**Table 1. Annual N ranges by species for established turfgrasses of North Carolina.[a]**

| | Importance of Appearance and Quality | | |
|---|---|---|---|
| | High | Moderate | Low |
| Turfgrass Species | Annual pounds of N per 1,000 sq. ft. (multiply by 43.5 for rate/acre) | | |
| Bahiagrass | 1 | — | — |
| Bermudagrass (Common) | 3-6[b] | 3-4 | 2-3 |
| Bermudagrass (Hybrid) | 6-12[b] | 3-6 | 2-3 |
| Centipedegrass | 1-1.5 | 0.5-1 | — |
| Fescue (Fine) | 2-3 | 2-3 | 1-2 |
| Fescue (Tall) | 3-4 | 2-3 | 1-2 |
| Kentucky Bluegrass | 4-6 | 2-3 | 1-2 |
| Perennial Ryegrass | 3-4 | 2-3 | 1-2 |
| St. Augustinegrass | 3-4 | 2-3 | 1.5-2.5 |
| Zoysiagrass | 3-6 | 2-3 | 1-1.5 |

[a] Light, frequent applications of fertilizer are suggested when attempting to rejuvenate an area thinned by pest or environmental stress. Higher rates within a range are for regions where the growing season is long. Newly established areas may require slightly higher (50%) rates for the first 3 to 6 months.

[b] Higher rates of N may be required if Bermudagrass is overseeded with a cool-season grass or if the Bermudagrass does not go dormant.

**Table 2. Recommended N fertilization rates and application schedule by species for turfgrasses commonly grown in North Carolina.**

| Turfgrass species | Target pH | Pounds N/1,000 sq. ft. | % Nitrogen to apply by season | | | |
|---|---|---|---|---|---|---|
| | | | Spring | Summer | Fall | Winter |
| Bahiagrass | 6.0-7.0 | 0.5 | 35 | 55 | 10 | 0 |
| Bermudagrass (Common* | 6.0-7.0 | 0.5-1.5 | 35 | 55 | 10 | 0 |
| Bermudagrass (Hybird)* | 6.0-7.0 | 0.5-1.5 | 35 | 55 | 10 | 0 |
| Centipedegrass | 5.0-6.0 | 0.5 | 35 | 55 | 10 | 0 |
| Fescue (Tall) | 6.0-7.0 | 0.5-1.0 | 20 | 10 | 40 | 30 |
| Kentucky Bluegrass | 6.0-7.0 | 0.5-1.0 | 20 | 10 | 40 | 30 |
| Perennial Ryegrass | 6.0-7.0 | 0.5-1.0 | 20 | 10 | 40 | 30 |
| St. Augustinegrass | 6.0-7.0 | 0.5-1.0 | 35 | 55 | 10 | 0 |
| Zoysiagrass | 6.0-7.0 | 0.5 | 35 | 55 | 10 | 0 |

*Overseeded Bermudagrass schedule for % nitrogen by season: spring—35; summer—35; fall—15; winter—15.

**Table 3. Characteristics of nitrogen carriers.***

| Fertilizer source | N content (%) | Leaching potential | Burn potential | Low temp. response | Residual effect |
|---|---|---|---|---|---|
| Quick Release | | | | | |
| *Inorganic* | | | | | |
| Ammonium Nitrate | 33-34 | High | High | Rapid | Short |
| Ammonium Sulfate | 21 | Moderate | High | Rapid | Short |
| *Organic* | | | | | |
| Urea | 45-46 | Moderate | High | Rapid | Short |
| Slow Release | | | | | |
| IBDU | 31 | Mod./Low | Low | Moderate | Moderate |
| Urea formaldehyde | 38 | Low | Low | Very Low | Mod./Long |
| Sulfur Coated Urea | 22-38 | Low | Low | Moderate | Moderate |
| Polymer Coated Urea | 10-20 | Low | Low | Low | Moderate |
| *Natural Organics* | | | | | |
| Sewage Sludge | 6 | Very Low | Very Low | Very Low | Long |
| Other Natural Products | 3-10 | Very Low | Very Low | Very Low | Long |

*Any combination fertilizer product applied to turf should contain at least 50 percent of the nitrogen in slowly available form.

liquid or granular form. In the soil, urea is rapidly converted to the plant-available ammonium form.

Slow-release nitrogen sources provide a more controlled release of nitrogen with longer residuals. Nitrogen applied in slow-release form is less likely to be lost to groundwater through leaching than quick-release products.

Products like IBDU or urea formaldehyde rely on chemical and/or microbial activity for slower release of plant-available nitrogen. Some urea formaldehyde products are available as solutions or suspensions that can be applied in liquid form. Sulfur- and polymer-coated urea rely on the coating to control the release of plant-available nitrogen into the soil solution.

Natural organic sources that release nitrogen slowly include processed municipal sewage sludge, composted plant or animal debris, and various other organic wastes. Because plant-available nitrogen is released from these products through chemical and microbial activity, the pace of release of plant-available nitrogen from these sources will vary with soil moisture and temperature. Warm, moist conditions favor high levels of microbial activity, which accelerate the release of nitrogen.

### Lime and Soil pH

Keep pH within the preferred range to make the best use of nutrients and to maintain a favorable rooting environment. Dolomitic limestone that contains both calcium and magnesium is recommended. Incorporate lime during seedbed preparation or apply to surface of established lawns.

# Best Management Practices for Commercial Lawn Care

| Fertilizer BMPs | Comments |
|---|---|
| Base fertilizer rates (except nitrogen) on soil test results.<br><br>A plant tissue analysis may also indicate nutrient needs and is especially useful in diagnosing a deficiency. | Most newly planted areas should be tested during the construction phase and every 1 to 2 years after that. Sample to a uniform depth in the root zone (3 or 4 inches). Take 15 to 20 soil cores from each area being tested, using a 1-inch diameter soil probe. Mix the cores thoroughly in a plastic container or paper bag. Do not use a metal bucket because it may affect the results. Submit samples to the Agronomic Division—NCDA&CS, 4300 Reedy Creek Road, Raleigh, NC 27607-6465. Results may not be available for several weeks, so plan ahead to have the information you need before you must decide on a fertilizer application.<br><br>Apply recommended dolomitic lime according to soil test. |
| Core or aerify compacted soil before application. | This is especially important to reduce phosphorus runoff. |
| Use a lower rate on slopes. | Use no more than 0.25 to 0.50 pounds of nitrogen per 1,000 square feet per application and make applications more frequently. |
| Maintain a buffer of natural vegetation or low-maintenance grass as a border for any water adjacent to the lawn. | Buffers trap and filter nutrients before they runoff into surface waters or leach into groundwater. A buffer width of only 15 to 25 feet is very effective in trapping sediment and nutrients. |
| Use a slow-release form of nitrogen on sandy soils. | If you must use a quick-release nitrogen on sandy soils or near shallow water tables, use no more than 0.25 to 0.50 pounds per 1,000 square feet per application. |
| Do not fertilize before irrigation or heavy rain. | Irrigate lightly (0.25 to 0.50 inches) after application of quick-release fertilizer to move it into the soil. Light irrigation decreases runoff losses and volatilization and reduces the risk of foliar burn. |
| Use iron for greening response instead of nitrogen. | Iron alone or in combination with nitrogen provides a greening response. Rates will vary with grass type and environmental conditions. |
| Leave grass clippings on the lawn. | Every 100 pounds of dried grass clippings contains 4 pounds of nitrogen, 1/2 pound of phosphorus, and 2 pounds of potassium. |
| Keep fertilizer off of impervious areas and away from surface waters. | Use a drop spreader near water and paved areas. A centrifugal (rotary) spreader has a much higher risk of depositing granules on paved surfaces or adjacent waterways. |

| Irrigation BMPs | Comments |
|---|---|
| Water to wet the soil to a depth just below the current root zone. | Excess water does not benefit the plant and may leach contaminants into groundwater and make turf weaker and more susceptible to pests and environmental stress. Temperature, wind, relative humidity, and soil moisture affect plant water use. Underirrigation produces wilt and desiccation. |
| Do not irrigate slopes, compacted soils, and sandy soils to the point of runoff. | Use short, frequent applications to allow water to move into the soil before applying any more. |
| Do not water a surface before heavy use. | Heavy traffic on a wet soil leads to compaction, which may lead to runoff. |
| Adjust irrigation equipment to apply a uniform level of water at the desired rate and time. | Test the irrigation system from time to time to make sure it is producing an acceptable level of uniformity. Do not allow spray patterns to deposit water on paved surfaces. |
| Schedule irrigation to minimize losses to evaporation. | Evaporation losses are highest in midafternoon. Schedule irrigation to give plants time to dry before nightfall. |

| Mowing BMPs | Comments |
|---|---|
| Maintain the correct grass height. | Keeping grass at the right height encourages deeper roots and reduces the potential encroachment of weeds. Use the highest acceptable mowing height. |
| Do not mow when the grass is wet. | Mowing wet grass results in clumps of clippings and the spread of disease. |
| Leave clippings on the lawn. | Leaving clippings to decompose and return nutrients to the lawn can reduce nitrogen needs by an average of 25 percent per application. Do not leave grass clippings on paved surfaces or allow them to blow into surface waters. |
| Keep the thatch layer under 1/2 inch. | The thatch layer of partially decomposed organic matter just above the soil surface can be effective in capturing and breaking down pesticides. When it is too thick (over 1/2 inch), thatch creates a favorable environment for insects and plant pathogens. Thatch can be reduced by vertical mowing, coring, and topdressing. Do not use vertical mowing on fescue. |

| Lawngrass | Height after Mowing (inches) |
|---|---|
| Bahiagrass | 2 to 3 |
| Bermudagrass | 3/4 to 1 1/2 |
| Centipedegrass | 1 to 1 1/2 |
| Fescue (Fine) | 1 1/2 to 2 1/2 |
| Fescue (Tall) | 2 1/2 to 3 1/2 |
| Kentucky Bluegrass | 1 1/2 to 2 1/2 |
| Perennial Ryegrass | 1 1/2to 2 1/2 |
| St. Augustinegrass | 2 to 3 |
| Zoysiagrass | 3/4 to 1 1/2 |

| IPM Program Components | Comments |
|---|---|
| Know the grass variety, pests likely to be problems, and conditions that may affect pest incidence. | If problems occur, make a positive diagnosis of the disease, insect, or weed problem before beginning any treatment program. Some pest problems will be outgrown or disappear as weather conditions change. |
| Define threshold levels and develop an IPM management plan with objectives for each section of the lawn and the degree of acceptable injury from pests. | Management practices, including nonchemical control measures, should be specified for each section of the site. Determine what is acceptable for each site, such as whether weeds should be allowed in low-maintenance settings or how many insects can be tolerated per square foot. Some threshold levels have been reported for certain insects (see *Turfgrass Pest Management Manual*, AG-348). |
| Monitor pest activity. | Most pests are easiest to manage when they are immature and few in number. Frequent scouting can help determine when pest activity or injury is in its initial stages (see treatment, timing, and pest life cycle charts in *Turfgrass Pest Management Manual,* AG-348). |
| Use appropriate cultural practices. | Good site preparation, selection of adapted varieties, and adequate water and nutrients will help establish a healthy, dense, vigorous turf that is better able to ward off pests and pest injury. |
| Keep accurate records. | Up-to-date records of pest activity, actions taken, and the results of those actions will help with future planning and may be useful in legal liability cases. |

## Advising Homeowners

**Irrigation**

If you give watering recommendations to homeowners, make sure that they know how to protect water quality. They may not know that brown, withered leaves on cool season grasses during a drought are a normal sign of dormancy. When a lawn is allowed to go dormant, it only needs to be thoroughly watered once every three weeks (in the absence of rainfall) to prevent injury to grasses due to heat and drying.

**Watering Tips for Homeowners**

- ✓ Turn off set times for automatic systems to avoid improper watering and to promote water conservation.
- ✓ Water until the soil is moist just below the root system. If you observe standing water, shut the system off and wait for the existing water to enter the soil. Water at intervals until the root zone is moist.
- ✓ Do not irrigate again until signs of wilting appear or footprints linger on non-dormant grasses. A soil probe can help determine soil moisture at the depth of the root zone.
- ✓ Sloped areas, compacted soils, and sandy soils need to be irrigated in short, frequent intervals.
- ✓ Water in the early morning for best results. If you must water in the evening, allow time for the grass to dry before nightfall to lessen the risk of disease. Avoid midafternoon watering to reduce loss from evaporation.

**Mowing**

If homeowners are responsible for mowing, pass along the following guidelines.

**Mowing Tips for Homeowners**

- ✓ Remove only a third of the grass plant when mowing. If grass gets very long, raise the mower for the initial cutting and gradually lower the mower to the proper height.
- ✓ To avoid compacting and clumping of clippings, do not mow when grass is wet.
- ✓ Leave grass clippings on the lawn. Clippings contain nitrogen that can cut fertilizer rates by 25 percent at each application.
- ✓ If you cannot leave grass clippings on the turf, try to compost them for other use as a soil conditioner or mulch. *Composting: A Guide to Managing Organic Yard Wastes,* (Extension publication AG-467), provides good information about composting yard materials.

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